

Claims

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1. A lithographic projection apparatus comprising:  
an illumination system for supplying a projection beam of radiation;  
5 a first object table provided with a first object holder for holding a mask;  
a second object table provided with a second object holder for holding a substrate;  
and  
a projection system for imaging an irradiated portion of the mask onto a target  
portion of the substrate; characterised by:  
10 at least one optical element having a surface on which radiation of the same  
wavelength as the radiation of said projection beam is incident and a capping layer  
covering said surface, said capping layer being formed of a relatively inert material.
2. Apparatus according to claim 1 wherein said relatively inert material is more inert  
15 than the material from which the remainder of said optical element is formed.
3. Apparatus according to claim 1 or 2 wherein said relatively inert material is less  
easily oxidised than the material from which the remainder of said optical element is  
formed.  
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4. Apparatus according to claim 1, 2 or 3 wherein said relatively inert material is  
harder than the material from which the remainder of said optical element is formed.
5. Apparatus according to any one of claims 1 to 4 wherein said optical element is a  
25 beam modifying element.
6. Apparatus according to claim 5 wherein said optical element is a reflector having a  
multilayer coating on which said capping layer is provided.

A2 > 30 ~~7~~ Apparatus according to any one of claims 1 to 4 wherein said optical element is a  
sensor.

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8. Apparatus according to anyone of the preceding claims wherein said capping layer has a thickness in the range of from 0.5 to 10nm, preferably from 0.5 to 6nm and most preferably from 0.5 to 3nm.
- 5 9. Apparatus according to any one of the preceding claims wherein said relatively inert material is selected from the group comprising: diamond-like carbon (C), boron nitride (BN), boron carbide (B<sub>4</sub>C), silicon nitride (Si<sub>3</sub>N<sub>4</sub>), silicon carbide (SiC), B, Pd, Ru, Rh, Au, MgF<sub>2</sub>, LiF, C<sub>2</sub>F<sub>4</sub>, and TiN and compounds and alloys thereof.
- 10 10. Apparatus according to any one of claims 1 to 8 wherein said capping layer comprises two or three sub-layers of different materials.
11. Apparatus according to claim 10 wherein said optical element comprises a reflector having a multilayer reflective coating on said surface, said multilayer reflective coating
- 15 comprising a plurality of layers of a first material having a relatively low refractive index at the wavelength of said projection beam alternating with layers of a second material having a relatively high refractive index at said wavelength; and said capping layer comprises:
- 20 a first sub-layer of said first material, a second sub-layer of a third material having a refractive index at said wavelength higher than said first material and and being more inert than said second material, and a third sub-layer formed of a fourth material that is relatively inert, said first, second and third sub-layers being provided in that order with ~~said third sub-layer outermost.~~
- 25 12. Apparatus according to claim 11 wherein said third material has a refractive index at said wavelength greater than about 0.96 and an extinction coefficient at said wavelength less than about 0.01.
- A3 → 13. Apparatus according to claim 12 wherein:
- 30 said first material is one or more materials selected from the group comprising: Mo, Ru, Rh, Nb, Pd, Y and Zr, as well as compounds and alloys of these elements;

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said second material is one or more materials selected from the group comprising Be, Si, Sr, Rb, RbCL and P as well as compounds and alloys of these elements;

said third material is selected from the group comprising B<sub>4</sub>C, BN, diamond-like C, Si<sub>3</sub>N<sub>4</sub> and SiC; and

5        said fourth material is selected from the group comprising Ru, Rh, Pd and diamond-like C.

14.    Apparatus according to any one of the preceding claims wherein said projection beam comprises extreme ultraviolet radiation, e.g. having a wavelength in the range of  
10    from 8 to 20nm, especially 9 to 16 nm.

15.    A device manufacturing method using a lithographic apparatus comprising an illumination system for supplying a projection beam of radiation;  
a first object table provided with a first object holder for holding a mask;  
15    a second object table provided with a second object holder for holding a substrate;  
and  
a projection system for imaging an irradiated portion of the mask onto a target portion of the substrate; said method comprising the steps of:

providing a mask containing a pattern to said first object table;  
20    providing a substrate at least partially covered by a layer of energy-sensitive material to said second object table;  
irradiating said mask and imaging irradiated portions of said pattern onto said substrate; characterised in that:

said lithographic projection apparatus comprises at least one optical element  
25    having a surface on which radiation of the same wavelength as the wavelength of said projection beam is incident and a capping layer covering said surface, said capping layer being formed of a relatively inert material.

16.    A device manufactured in accordance with the method of claim 15.

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Add B5 >

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